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CHAPTER 22

NEURAL ORGANIZATION FOR EMOTIONAL EXPRESSION

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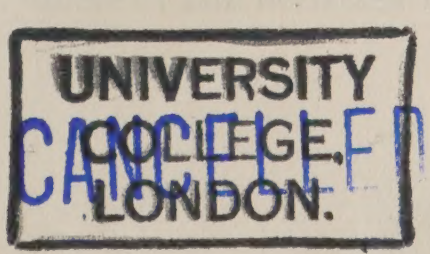
In this paper I shall restrict myself primarily to a consideration of a typical reaction system of the more highly developed organisms, that which is commonly called an expression or outburst of *anger* or *rage*. Later I shall consider some bearings which the facts may have on the nature of emotional excitation.

The complex of bodily alterations that appears in rage has many features resembling the simple reflexes, such as sneezing, coughing, and sucking. First, its occurrence in the early months of even so highly developed an organism as the human infant indicates that its neural pattern, like that of the reflexes mentioned above, is congenitally inwrought in the central nervous apparatus. Second, as in the reflexes, it is a prompt response to the appropriate stimulus. Again, it is a constant and uniform response—so much is this so, indeed, that there is no mistaking its character, whether it be manifested by the diverse races of man or by the lower animals. It is like the reflexes, also, in being a permanent mode of reaction; throughout life the characteristic display of the rage-response may be suddenly evoked in all its elaborateness. Further, it is a response to a fairly definite stimulus—an inner stimulus which arises when there is a hampering or checking of motion or an opposition to one or another primary impulse. Finally, the rage-response is like the simple reflexes in being useful. Elsewhere (1) I have called attention to the wide range of bodily adjustments which occur in an enraged animal—the more rapid heart-beat, the redistribution of the blood, the increase of red corpuscles in the circulation, the deeper ventilation of the lungs, the dilatation of the bronchioles, the liberation of sugar from the liver, the secretion of adrenin with its favorable action on fatigued muscles—all of which may properly be regarded as rendering the organism more efficient in struggle, in such struggle as may be necessary to overwhelm the opposition and to allow the natural impulse to prevail. Thus, as should be clear, all the main features of the simple reflexes—the inborn prompt, constant, uniform,



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permanent, and utilitarian nature of the response to a definite type of stimulus—all these features of the simple reflexes are reproduced in the characteristics of an outburst of rage.

Much evidence exists which indicates that, whereas delayed responses—uncertain, temporary, and readily modifiable—involve the cerebral cortex the prompt, uniform, and stereotyped reactions to stimuli have their central locus in lower levels of the brain and spinal cord. It becomes a matter of interest, therefore, to inquire regarding the seat of the neural mechanism which operates the action complex of rage. Does this mechanism have its locus in the cortical neurones or in the more primitive parts of the nervous axis?

In the brain-stem there s a group of centers which, in the lower vertebrate, lacking a cerebral cortex, carry on elementary functions for maintaining existence. In higher forms these centers, though normally held in check by the dominant cortex, are capable of energetic response when conditions demand urgent and impulsive action. If the cortical government is set aside the subordinate activities become prominent. Goltz's (2) and Rothmann's (3) hemisphereless dogs and de Barenne's (4) cats deprived of the neopallium illustrate this point. These animals under various conditions reacted commonly with signs of rage. Goltz's dog exhibited a typical outburst of fury when taken from his cage to be fed—barking loudly, snapping in all directions, and resisting vigorously. Trifling stimuli, such as pulling or pressing the skin, called forth similar excesses of emotional response. The behavior of Rothmann's dog was of the same type. Gentle scratching of the back was the occasion for snarls and growls, and the presence of a fly on the dog's nose would send him into a fit of rage. With de Barenne's cats, pinching the toes or skin produced energetic movements of defense and such reactions as are characteristic of the angry cat—spitting, growling, and erection of the hairs of the tail and back. Again very slight disturbance proved an effective stimulus for this response; even the act of lifting the cats from the floor would evoke it.

These various instances of a typical rage-reaction appearing in animals deprived of the cerebral cortex may be interpreted as examples of "release phenomena," to use the term introduced by Hughlings Jackson (5)—phenomena resulting from the activity of lower centers in the cerebrum that appear readily on slight stimulation when the dominance of the superior centers is removed. It seemed reasonable to expect that these lower centers might display their typical activity after removal of the cortex in an acute experiment. Decortication would eliminate an essential condition for sensation and therefore the use of a depress-

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ing or disturbing anaesthetic could be dispensed with. Accordingly Britton and I (6), using cats as subjects, undertook an investigation of some of the immediate effects of decortication. A stylet, pressed through the upper, inner quadrant of the left bony orbit and then to the bony tentorium on the opposite side of the skull, was swept downward and outward and withdrawn along the floor of the brain case. A similar operation was performed through the right orbit. Thus the cerebrum was substantially decorticated and almost all of the ganglia at the base of the brain remained intact. As soon as recovery from anaesthesia was complete, a remarkable group of activities appeared, such as are usually seen in an infuriated animal—a sort of sham rage. A complete list of these quasi-emotional phenomena which we observed is as follows: vigorous lashing of the tail; arching of the trunk, and thrusting and jerking of the limbs in the thongs which fasten them to the animal board, combined with a display of claws in the forefeet and clawing motions, often persistent; snarling; rapid head movements from side to side with attempts to bite; and extremely rapid, panting respiration. These activities occur, without special stimulation (apart from the operative trauma and confinement to the holder) in "fits" or periods, lasting from a few seconds to several minutes. During the intermediate quiet stages a "fit" could be evoked by slight handling of the animal, touching the paws or jarring the table. Besides these changes which involved skeletal muscle there were typical and more permanent effects produced by sympathetic impulses: erection of the tail hairs, which recurred again and again after they were smoothed down; elevation of the vibrissae; sweating of the toe pads; dilatation of the pupil to a size during activity that was threefold the size during a preceding quiet period; micturition; a high blood-pressure; an abundant outpouring of adrenin; and, as Bulatao and I (7) found, an increase of blood sugar up to five times the normal concentration. Because of the resemblance of some of these apparently spontaneous reactions to pseudaffective reflexes which Woodworth and Sherrington (8) were able to elicit in decerebrate cats by stimulation of sensory nerves, we used the term "pseudaffective" in designating the preparation. The animals may manifest this pseudaffective state, or sham rage, at short intervals for two or three hours before the arterial blood-pressure falls too low for continuance of activity.

The pseudaffective phenomena observed by Woodworth and Sherrington, and also by Bazett and Penfield (9) in "chronic" decerebrate preparations, were disturbances of an otherwise fairly continuous rigidity. In decerebration the cut passes through the mid-brain (*M*, Figure 1); thus the diencephalon and all parts of

the cerebrum anterior to it are excluded from action. Obviously that part of the neural organization which *directly* sends forth the rage-response lies posterior to the section through the mesencephalon, i. e., in the remnant of the mid-brain or in the medulla. In these decerebrate animals, however, spontaneous exhibitions of sham rage are rare; relatively strong stimulation is required to evoke them, and, when evoked, they are likely to be isolated items of the total reaction and may be associated at times with inconsistent elements, such as violent clawing accompanied by purring. This is in marked contrast to the intense and complete manifestation of fury which may be shown by decorticate animals. The difference in behavior of the two preparations must be referred to some part of the brain-stem lacking in the decerebrate, but present in the decorticate animal. In other words, although various parts of the rage-response can be activated by afferent impulses in the bulbospinal animal, the integration of these responses in an energetic and typically widespread outburst of rage appears to be controlled by a superior center. Britton and I left untouched almost all of the basal gray matter of the anterior brain-stem. Where among these basal ganglia does the dominating center reside? This question has been the subject of an investigation by one of my collaborators, Dr. Bard.

The method employed by Bard was that of ablating various amounts of the brain-stem after decortication, and studying thereafter the behavior of the preparation. He found that typical sham rage, accompanied by vigorous discharge of sympathetic impulses recurs in spontaneous fits or outbursts after both cerebral hemispheres, the corpora striata and the anterior half of the diencephalon have been removed completely (along dash line, Figure 1). The additional removal of the posterior half of the diencephalon promptly abolishes the spontaneous activity; but since it persists after much of the dorsal portion of the region has been cut away (along dotted line, Figure 1), the dominating center, we may infer, is situated near the base, probably in the subthalamus. Its size in the cat is less than a fourth of a cubic centimeter. In recent years considerable evidence has accumulated, pointing to the thalamic region as the central station of the sympathetic system. Isenschmid and his collaborators (10) have localized there the mechanism for temperature regulation—a mechanism controlling heat-production and heat-loss via sympathetic channels. And Karplus and Kreidl (11) have observed that local stimulation of the same region in anaesthetized animals causes a sympathetic discharge. Bard's observations bring strong support to the conclusion that in the subthalamus there exists an integrating center for sympathetic activities. Thus in the

diencephalon, in a part of the old brain, which is common to all members of the vertebrate series from the fishes to mammals, is localized the neural apparatus for integrating the complex reaction system of rage, not only the external expression, but also the internal mobilization of the bodily forces for the violent physical efforts in which rage typically culminates.

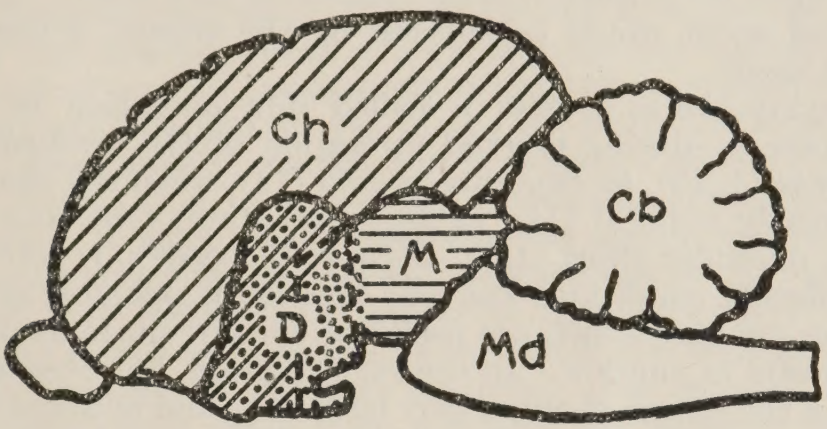

FIGURE 1

DIAGRAM OF THE MID-SECTION OF THE CAT BRAIN

Ch, cerebral hemispheres; *D*, diencephalon (dotted); *M*, mesencephalon; *Cb*, cerebellum; *Md*, medulla. The parts distinguished by slanting lines can be wholly removed without destroying the rage-response.

Besides the central neural organization there are the peripheral effector organs. They are in two divisions—the skeletal muscles and the viscera. The skeletal musculature is so played upon that a characteristic picture is presented. I have described above the appearance of the infuriated cat. Darwin's (12) description of rage in young children is not very different; during a violent outburst they scream, kick, scratch, and bite. In adult men the display is not commonly of this puerile type, but it is likely to include the crouching body, the moist and frowning brow, the firm lips, the clenched or grinding teeth, the growled threats and imprecations, and the tightened fists or the seized weapon ready for attack.

Important visceral alterations accompanying fury I have recounted above. They are profound and widespread. They are called forth by discharges through the sympathetic division of the autonomic system. The neurones of this division are so arranged, as I have noted elsewhere (1), that they discharge impulses diffusely to smooth muscles and glands in all parts of the body. Among the glands is the adrenal medulla—a gland of internal secretion. Thus at the same time with the diffuse emission of sympathetic impulses there is liberation of adrenin (13). The

adrenin, which is poured into the blood stream, necessarily has a general distribution and therefore a diffuse action. Everywhere that it acts in the body, it has the same effect as the nerve impulses—i. e., the humoral and the neural agents cooperate. Indeed, this cooperation of the ubiquitously distributed adrenin and the nerve impulses confirms the concept that the sympathetic neurones are arranged for diffuse effects—otherwise any special action by the neural agent would be covered by the general action of the humoral agent.

The sympathetic system is called into operation in various circumstances—during marked excitation of the cerebrum as in fear or rage (1, 13), on exposure to cold (14), when the blood sugar is too greatly reduced (15), in asphyxial states (16), and in very vigorous muscular effort (13). Because the system is activated in quite different conditions and also because it operates as a unit, it induces changes which are useful in one circumstance but may not be useful in another. In the rage-reaction, however, as noted above, all the known changes may be readily and reasonably interpreted as rendering the organism especially capable of enduring prolonged and extreme physical effort.

Although activation of the sympathico-adrenal system is a prominent feature in an outburst of rage, it is not an essential feature. Recently Lewis, Britton, and I (17) have succeeded in removing completely both sympathetic trunks, from the superior cervical to the pelvic ganglia, in cats, keeping the animals healthy and vigorous in the laboratory for many months, and noting that in appropriate circumstances they exhibit almost all the superficial signs of rage. Thus, one of these animals, which had given birth to kittens, showed her teeth, drew back her ears, lifted a front leg ready to strike, and growled and hissed, when a barking dog approached her young. The hairs, however, did not bristle on any part of her body, and vigorous struggle resulted in no increase of blood sugar. In animals with the adrenals, liver, and heart wholly disconnected from the central nervous system the rage-response occurs, as Lewis, Britton, and I (18) have shown, quite as in normal animals, even to the appearance of a bushy tail, without, however, any discharge of adrenin or noteworthy acceleration of the heart. In these cases there is no reason for supposing that the peripheral operations have disturbed the established pathways in the central neurones. If the central neurones are connected with the muscles of the tail hairs, the hairs stand, otherwise they lie flat; if the nervous connections reach to the adrenal glands, adrenin is discharged, otherwise not. In short, the central neurones discharge in their fated manner; and the activity or absence of activity in effector organs depends on the presence or absence of connections with the spinal cord.

Thus far I have given an objective account of physiological facts related to a typical emotional expression—that of rage. Do not these facts have implications pertinent to other emotions? Do not they help towards an understanding of the nature and functions of emotion in the behavior of the organism? May I venture to suggest that they do, and attempt to present some reasons for that suggestion.

A fundamental fact which I would emphasize is that the neuro-muscular and neuro-visceral arrangement for the display of rage has its central control congenitally organized in or near a phylogenetically ancient part of the brain, the optic thalamus. The thalamus is not like the cerebral cortex in being a region where new relations with the outer world are registered and old relations are modified; it more nearly resembles the spinal cord—a region under superior dominance, where afferent impulses are received, regrouped, and redistributed either to the higher levels, or to neighboring motor neurones which promptly discharge to effector organs in stereotyped reaction patterns. The typical postures and attitudes which result from action of the thalamus are more complicated than those produced by spinal reflexes but are not essentially different. The physiological organization which establishes the reflex figure of rage I have detailed because it may serve as a prototype for other primitive emotional responses. The expressions of fear, joy, and grief are similar in character; in their essential features they are not learned, and they are exhibited so early in the human infant that they may properly be classed with rage as being natively inherent in the brain. There is good evidence that central control for the expression of these emotions, like that for rage, lies subcortically and, specifically, in the thalamic region. Bekhterev (19) has reported that whereas "painful" stimulation excites cries in an animal freshly deprived of its cerebral hemispheres, gentle stimulation ("petting") may evoke signs of pleasure, e. g., purring in the cat and tail-wagging in the dog. These responses disappeared, in his cases, after removal of the optic thalamus. In human beings indications of a subcortical management of emotional expression are to be seen in the effects of anaesthetics. During the second (excitement) stage of ether anaesthesia, there may be sobbing as in grief, or laughter as in joy, or lively and energetic aggressive reactions as in rage—all without refined or even definite adjustments to the environment. The surgeon may open the chest or perform other operations of equal gravity, while the patient is pushing, pulling, shouting, and muttering, and yet the events leave no trace in the cortex which yields later a memory of what has happened. A peculiar effect of nitrous oxide anaesthesia has led to its common name, "laughing gas,"

though an experienced anaesthetist has informed me that under its influence quite as many patients weep as laugh; in either event, when cortical functions have been so deeply abolished by this gas that the patient has no experience from an ordinarily painful procedure, there is a release of the typical expressions of gladness or sorrow. Pathological cases support these indications of a subcortical source of emotional behavior. In certain forms of hemiplegia the patient is incapable of moving the face on the paralyzed side; but if he is suddenly affected by an occasion which is gay or sad, the muscles which have been dissociated from cortical government act properly to give the face the expression of joy or sadness (19). The clinical studies of Head and Holmes (20) have brought evidence of a more precise localization of centers for emotional acts. They noted that such unilateral damage to the brain as isolates parts of the thalamus from the cortex has a most remarkable consequence in the excessive responses to "all potentially affective stimuli." The prick of a pin, painful pressure, excessive heat and cold, all produce a more vigorous unpleasant feeling on the abnormal than on the normal side of the body. At the same time, pleasurable warmth may evoke an unusually vivid pleasant response. And they conclude that since the affective states are increased when the thalamus is freed from cortical control, "the activity of the essential thalamic center is mainly occupied with the affective side of sensation." Similar testimony to residence of the neural mechanisms for affective expression in the brain-stem is afforded by anencephalic monsters—the so-called "frog-babies," born without cerebral hemispheres and often having little more than the medulla and cerebellum. Even with such a poor remnant of the brain as that, noxious stimulation will cause whimpering and drawing down of the corners of the mouth as in distress and grief (21). In all these instances of absence of cortical function, primitive emotional reactions are as perfectly performed as are the reflexes of coughing, sneezing, sucking, and swallowing, i. e., they are complicated automatisms. In all these complicated acts the nerve impulses run their appointed course according to phylogenetic patterns and without individual instruction or training.

A second point on which I would lay emphasis is the intensity of the rage-reaction which we observed in pseudaffective animals. Many years ago Hughlings Jackson (5) made the suggestion, recently supported by Head (22), that the nervous system is organized in a neural hierarchy, such that primitive reactions, which might otherwise disturb the more discriminative responses of higher levels, are by these repressed. When the cortical government is set aside, the subordinate activities, released from in-

hibition, become prominent. Then only slight stimulation is required to produce extreme effects. Thus may be explained the violent and persistent display of sham rage by our decorticate cats while fastened to a holder, the vigorous snapping, snarling, and resistance of the hemisphereless dogs when taken from their cages, and the excessive responses to mildly affective stimuli by human beings with thalamus freed from the cortex. The extraordinary intensity of these exhibitions seems to indicate that the neural apparatus for emotional expression is set and ready for energetic discharge, and that if only the superior control is weakened or inhibited, appropriate stimuli evoke an intense and powerful response. If external conditions should be such as to call forth an emotional response, therefore, a definite innervation of effector organs from the cortex would not be required; withdrawal of cortical dominance would be the main condition for prompt and vigorous action. But the cortical government may not release the excited neurones in the thalamus. Then there is conflict between the higher and lower controls of bodily activities—there are opposing tendencies with accompanying confusion. The cortical neurones, however, can check only some of the bodily activities, those which are normally under voluntary control. It cannot check the stormy processes of the thalamus which cause shivering and forcible emptying of the bladder and rectum. In states of conflict these phenomena become prominent.

A third point—since cognitive consciousness is associated with the functioning of cortical neurones, it follows, as a corollary from the facts cited above, that the neural mechanisms for the primitive emotions operate in a region outside the range of such consciousness. This consideration, together with the readiness of these mechanisms, when released from inhibition, to exhibit a major response to a minor stimulus, explains, I think, some of the most characteristic features of emotional experience. We have emotional "seizures"; we laugh, weep, or rage "uncontrollably"; we feel as if "possessed"; what we do in the stress of excitement is "surprising," "shocking"—something "surges up within us" and our actions seem no longer our own. These common bywords are explicable in terms of a sudden and powerful domination of the bodily forces by subcortical neurones. Under favoring circumstances, with only a momentary lifting of the normal inhibitory check, these neurones capture the effector machinery and drive it violently into one or another of its variegated attitudes.

And finally, it seems to me that the facts presented above suggest a new source for the peculiar feelings which we experience in an emotional upset. We are familiar with James's (23) idea

that the feeling of the bodily changes, which occur spontaneously in an exciting situation, constitutes the emotion; and also with the similar idea of Lange (24) that consciousness of cardio-vascular disturbances is the essential element. Elsewhere I (1) have pointed out that any high degree of excitation in the central nervous system, whether felt as anger, terror, pain, anxiety, joy, grief, or deep disgust, may rouse the sympathetic system to activity and affect in a stereotyped fashion the functions of organs which that system innervates. May I recall that the central station for the sympathetic system is a small, compact center in the diencephalon, and, furthermore, that when strongly aroused, that system tends to act as a unit. The responses in the viscera, therefore, are too uniform to offer a satisfactory means of distinguishing states which, in man at least, are very different in subjective quality. For this reason I urged that the differential features separating one emotion from another could not be found in diverse afferent impulses from the viscera. Furthermore, as Marañon (25) has shown, injections of adrenalin into human beings in amounts which induce the visceral changes characteristic of emotional excitement do not in fact produce an emotional experience; the subject merely becomes reminiscent of other times when these changes were noted—he reports them and remains calm. In addition, the afferents from the viscera, especially from cardio-vascular organs, are too meager to yield us any rich sensation based on the happenings within them. There remain as support for the James-Lange theory the positions and tensions of skeletal muscle that are peculiar to the various emotions. But forced laughter does not bring real joy, nor forced sobbing real sorrow, as it appears to me they should do if the peculiar *quale* of the emotion were derived from the innervated muscles themselves. Furthermore, Head (26) and his collaborators report that in thalamus cases the quality of feeling-tone, though markedly intensified in relation to other sensations, notably those resulting from certain tactile, auditory, and thermal stimuli, is entirely absent from such sensations as underlie an appreciation of posture. The theory of a peripheral source of emotional experience has little or no positive factual support. To produce an effect in the cortex, however, it is not necessary that afferent impulses arise at the periphery; they may be started anywhere in the afferent path. May not this happen in emotional excitement? The neurones of the subcortical centers in the cerebrum act in different combinations in the different emotional expressions, as proved by the reaction pattern, typical of the several affective states, which they induce. May not the "feeling" be due to impulses, not from the effector organs, but from the lower neurones

in the special combination which fixes at the moment the peculiar facies and bodily postures of the reaction system? These neurones, as we have seen, are organized in the basal gray matter, in the old brain. They do not require detailed innervation from above in order to be driven into action. Being *released* for action is a primary condition for their service to the body; they then discharge precipitately and intensely. We know that intense activity in one part of the nervous system extends to other parts by "irradiation." The phenomenon occurs in the gray matter of the cerebral cortex; it may occur likewise in the gray matter of the basal ganglia of the old brain-stem. Here, within or near the thalamus, the neurones concerned in emotional expression lie close to the relay on the sensory path from periphery to cortex. We may assume that when these neurones discharge in various combinations they not only innervate muscles and viscera but also affect afferent paths to the cortex by irradiation or by direct connections. Only in this way, I think, can we account for the phenomena observed when in human beings the optic thalamus is freed from cortical control by a unilateral lesion. All the emotional aspects of experience are greatly intensified on the injured side; in a case described by Head (26), though a tuning fork or a bell had no unusual effects, stirring music produced such intolerably intense feelings (referred to the affected side) that the patient was obliged to leave the room. Thus as an accompaniment of each emotional expression there could surge up from the old brain to the cerebral cortex impulses characteristic of the neurone pattern then prevailing. The quality of the emotion might arise from the obscure and unrelated source of the intruding impulses, from the sense of extraneous control of the bodily forces, and from the different combinations of the excited afferent neurones—each combination specific for a particular emotion. In other words, for the theory that emotional experiences arise from changes in effector organs is substituted the idea that they are produced by unusual and powerful influences emerging from the region of the thalamus and affecting various systems of cortical neurones. This view accords with the pertinent physiological facts now available. It can be applied to the "subtler" emotions, which the James-Lange theory had difficulty in explaining. It offers interesting suggestions for the study of emotional expressions experimentally in lower animals and in human beings under the influence of various drugs and in pathological states.

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DISCUSSION

Dr. Reymert: In opening the discussion of Dr. Cannon's paper, I want to say that we, as psychologists, are extremely fortunate in having a physiologist like Dr. Cannon with us. His works, as we all know, have exerted a great influence upon contemporary psychology, and his latter findings now will most likely bring

about some revisions which will have to be made in certain psychological conclusions and investigations. The paper is now open for discussion.

DR. WEISS (*Ohio State University*): I would just like to ask Dr. Cannon this question which was raised in part also as a response to Dr. Dunlap's paper. I agree, of course, with the findings that Dr. Cannon has presented. Now there is this, I think, which would be of extreme importance to psychologists: that is, what is the criterion of emotion and how many different kinds of emotions are there? That, I think, is somewhat unclear to some of us.

DR. CANNON: That is a question of very great importance and, I think, of fundamental importance. It seems to me that this conception that I have tried to bring before you tonight, that these patterns exist in the cortex early—I do not mean in the cortex, but in the brain early, in the thalamus early—allows us to make studies of the various reactions which the animal exhibits—and when I say the animal I mean human beings—in the first days of existence, and that possibly by such careful examination, such as Watson has already started, we can get a notion of how many emotions there are to start off with.

Now my notion is, and I am sure that there are others who have had the same idea, that these primitive responses become associated very much as responses become associated in cortical operations, so that we have all sorts of complicated combinations of emotional reactions that are dependent upon previous experiences. I have an emotion or an emotional feeling that is fairly intense and has been so for many, many years when I hear sleigh-bells, and it goes back to a time when I saw Henry Irving play "The Bells." I was a boy at the time and was immensely stirred by the terrific tragedy which he represented on the stage. Since then I cannot hear sleigh-bells without having a queer feeling inside of me, which I interpret as emotion. An association has been established between the sound of those bells and the experience which I had at that time, so that a recurrence of the sound of the bells brings back the emotions.

It is a very different matter to explain that emotion. At the time I had it I think it would have been an easier emotion to define if I had been introspective or had been watchful at the moment. These complications come as a result of experience. I am talking now to a lot of psychologists. I am only a physiologist, and I am not expert in psychological theorizing and speak upon some of these matters haltingly, but that would be my way of answering Dr. Weiss's question.

DR. WEISS: The results of some investigations which we are now conducting on new-born infants, beginning at birth up to about ten or twelve days, indicate that there are practically none of these emotional disturbances present at that early stage. You can take young infants, wind them tightly in a cloth, and they go to sleep. Hold their noses, which is usually an easy way of getting a strong emotional response from an adult, and they wiggle a bit and go to sleep. That is as far as we have been able to find with our experiments on young infants. We do not get the emotional responses, that is, the skeletal responses, except those organic responses. We do get those. But we get those also with other things, that is, not only with what we would call emotional stimuli, but we get it when we try to elicit a palmar reflex or a blinking reflex or an auditory reflex. We are likely to get any one or all of these things. So, as far as the new-born infant is concerned, I think there is very little opportunity there, as far as our researches go, to try to establish the fact that we have such a thing as a primary emotion, unless we eliminate all skeletal posture. If we consider the organic responses, we can see them. There is evidence of emotion. But we get those organic reactions without emotional stimuli.

DR. CANNON: May I ask any mother here to hold up her hand if she has heard the first cry of her baby? There have been persons who theorized about that first cry and they supposed that the first cry was due to the fact that the child suddenly found after being in heaven that he was in a very much worse place. I am quite sure that that expression of emotion, that cry, is heard almost immediately or very soon after birth, and I am sure that anything in the way of stimulation will bring that out.

1) Sympathetic. Thoraco-lumbar
Generalised diffuse impulses to smooth
muscle & glands. Release adrenalin
which supports & reinforces sympathetic
impulses & so more powerful

2) Cranial (Vagus) & Sacral vegetative
supply, acts in opposition to sympathetic
but is more particular & selective in
its action.

3) Accelerator of heart; depressor of alimentary
tract (sympathetic) & vaso-constrictor
in peripheral & splanchnic vessels; dilator
of bronchioles

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